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ABSTRACT

This research synthesis identifies areas of convergence in reading research regarding the importance, dimensions, and effects of phonological awareness on the reading acquisition process. It also highlights similarities and differences between normal achievers and diverse learners. The following five areas of research convergence are identified: (1) phonological processing ability explains significant differences between good and poor readers; (2) phonological awareness is a general ability with multiple dimensions; (3) phonological awareness has a reciprocal relation to reading acquisition; (4) phonological awareness is necessary but not sufficient for reading acquisition; and (5) phonological awareness is teachable and promoted by attention to instructional variables. Also discussed are issues of construct validity, the importance of explicit teaching of phonological awareness, the value of combining phonological awareness instruction with instruction in letter-sound correspondences, and the value of providing intense and explicit instruction in phonological awareness to diverse learners who may potentially have reading disabilities. A table allows comparison of the major studies reviewed. (Contains 32 references and 4 figures.) (DB)

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Synthesis of Research on Phonological Awareness: Principles and Implications for Reading Acquisition

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Synthesis of Research on Phonological Awareness: Principles and Implications for Reading Acquisition

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Running Head: PHONOLOGICAL AWARENESS

Synthesis of Research on Phonological Awareness: Principles and Implications for Reading Acquisition

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Introduction

Research of more than two decades has affirmed the importance of phonological awareness and its relation to reading acquisition. Thus, recent reviews of the literature (Hurford, Darrow, Edwards, Howerton, Mote, Schauf, & Coffey, 1993; Mann, 1993) indicated that the presence of phonological awareness is a hallmark characteristic of good readers while its absence is a consistent characteristic of poor readers.

Findings from a large body of research converge to suggest that students who enter first grade with little phonological awareness experience less success in reading than peers who enter school with a conscious awareness of the sound structure of words and the ability to manipulate sounds in words (Adams, 1990; Liberman & Shankweiler, 1985; Mann & Brady, 1988; Spector, 1995; Stanovich, 1985, 1986, 1988; Wagner, 1988). Many of the points made in this chapter are supported by multiple sources. Due to space limitations, however, we can not provide complete lists of support for every assertion and conclusion.

Two lines of research provide strong support that phonological awareness is part of a larger construct in coding and retrieving verbal information known as phonological processing (Hurford et al., 1993; Vellutino & Scanlon, 1987, 1987a; Wagner, 1986, 1988; Wagner & Torgesen, 1987). Results from phonological processing research further indicate that deficits in processing the phonological features of language explain a significant proportion of beginning reading problems and correlated difficulties in reading comprehension, background knowledge, memory, and vocabulary differences (Liberman & Shankweiler, 1985; Mann & Brady, 1988; Rack, Snowling, & Olson, 1992; Torgesen, Wagner, Simmons, & Laughon, 1990; Wagner & Torgesen, 1987).

In short, difficulties with awareness, coding, and retrieval of verbal sounds have powerful and long-reaching effects in reading. However, the most encouraging lines of research give strong evidence that significant gains in phonological awareness can be achieved with teaching and that the gains in phonological awareness directly affect the ease of reading acquisition and subsequent reading achievement.

Methodology

Overview of the Chapter

In this chapter, we identify areas of convergence in reading research regarding the importance, dimensions, and effects of phonological awareness on the reading acquisition of normal achievers and diverse learners. Over the last decade, phonological awareness has attracted extensive research and discussion. Because of the substantive research devoted to this topic and its validated relation to reading, the specificity of this chapter is unlike the scope of other chapters in this volume. Our rationale for a specific focus on phonological awareness is based on the importance of accounting for this extremely large body of research examining the relation between reading disability and phonological deficits. This importance stems from many sources and clusters around two areas of convergence: (a) phonological awareness is an underlying and critical dimension to early reading success, and (b) phonological awareness explains significant differences between good and poor readers. The areas of convergence align with our overriding purpose: (a) to identify areas of research convergence in reading, and (b) to highlight the similarities and differences in convergence between normal achievers and diverse learners.

Phonological awareness has been heavily researched because of its direct relation with the ability to read unfamiliar words independently with relative ease (Cornwall, 1992; Lenchner, Gerber, & Routh, 1990; Mann & Brady, 1988; Rack et al., 1992; Snowling, 1991; Stanovich, 1985, 1986; Torgesen, 1985; Vellutino & Scanlon,

1987, 1987a; Wagner, 1988; Wagner & Torgesen, 1987). In addition, the ability to hear and consciously use sounds in language can be manifested in many processes fundamental to reading. The characteristics, contexts, and conditions of learners and learning are discussed based on conclusions and data from a research synthesis. The points of convergence provide instructionally relevant findings and were derived from the following sources of information and through the following process.

Sources

We reviewed 28 sources including 13 primary studies (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1989; Cornwall, 1992; Cunningham, 1990; Hurford et al., 1993; Lie, 1990; Lenchner et al., 1990; Lundberg, Frost, & Petersen, 1988; Mann, 1993; O'Connor, Jenkins, & Slocum, 1993; Swanson & Ramalgia, 1992; Vellutino & Scanlon, 1987; Yopp, 1988). To provide a representative but manageable portrait of research, we limited our search to studies and reviews published between 1985 and 1993. The 15 secondary sources included 7 descriptive narratives (Liberman & Shankweiler, 1985; Mann & Brady, 1988; Snowling, 1991; Spector, 1995; Stanovich, 1985, 1986; Torgesen, 1985; Torgesen et al., 1990), 3 descriptive analyses (Vellutino, 1991; Vellutino & Scanlon, 1987a; Wagner & Torgesen, 1987), 1 deficit model (Stanovich, 1988), 2 reviews (Rack et al., 1992; Wagner, 1986), 1 meta-analysis (Wagner, 1988), and 1 book (Adams, 1990).

Further, the 13 primary studies included 7 intervention studies that examined the effect of phonological awareness intervention on phonological awareness, reading, and reading and spelling (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1989; Cunningham, 1990; Lie, 1990; Lundberg et al., 1988; O'Connor et al., 1993; Vellutino & Scanlon, 1987). Five of the primary studies were correlational and examined the relations among phonological awareness and memory, spelling, rapid naming, and prediction of future reading ability (Cornwall, 1992; Hurford et al., 1993; Lenchner et al., 1990; Mann, 1993; Swanson & Ramalgia,

1992). Finally, the last study examined the validity and reliability of existing phonological awareness measures (Yopp, 1988). Figure 1 provides a summary of the sources reviewed.

Participant Characteristics

Participants in the research reviewed included students identified as normally achieving, general low performers, learning and reading disabled, remedial readers not identified as learning disabled, high achievers, culturally disadvantaged, language delayed, and linguistically diverse. Normal achievement was examined in 11 of the 13 primary studies and was the focus of six studies. In contrast, six studies compared normal and diverse learners while one study focused only on diverse learners.

Subjects' ages ranged from preschoolers to students in the sixth grade, except for reviews that included subjects from preschool to adult. However, the majority of sources focused on kindergarten and first-grade children. With the exception of two primary studies conducted in Scandinavian countries (Lie, 1990; Lundberg et al., 1988) and studies included in literature reviews, all the sources targeted English-speaking subjects.

Review Process

Two independent reviews were conducted for each source. Responses were grouped under three categories (a) general conclusions, (b) learner characteristics, and (c) instructional implications. Convergence within the categories was achieved through a multiple-step process. Reliability was achieved through independent reviews, inter-coder comparisons of data categorization, coding clarification and refinement, and independent coding with reliability. To identify areas of convergence, the primary author of this chapter used the conclusions derived from the review and the coding process in concert with a second careful examination of each source.

Definitions

The research literature's of phonological processing and phonological awareness entail highly technical language. We offer the following definitions as a guide for the subsequent discussion of these complex concepts. In addition, we will embed selected definitions in the chapter to facilitate understanding.

Phonological awareness. Conscious ability to detect and manipulate sound (e.g., move, combine, and delete), access to the sound structure of language (e.g., Liberman & Shankweiler, 1985; Wagner & Torgesen, 1987), awareness of sounds in *spoken* words in contrast to *written* words.

Alphabetic understanding. Understanding that letters represent sounds and that whole words have a sound structure consisting of individual sounds and patterns of groups of sounds, the combination of alphabetic understanding and phonological awareness becomes the larger construct, alphabetic principle.

Automaticity. Quality of fluency; implies automatic level of response with various tasks, such as speed of retrieving the sound for a specific letter.

Grapheme. Written symbols or letters of the alphabet; arbitrary, abstract, and usually without meaning; the written equivalent of phonemes.

Phonemes. Individual sounds, smallest unit of sound.

Coding. Translating stimuli from one form to another (e.g., from auditory to written or from written to auditory); encoding is the first translation which involves coding auditory sound to phonological codes for use and storage; recoding involves the second-level translation that involves going from written symbols to their phonological equivalents (e.g., discrete graphemes to phonemes or written words to their pronunciations); retrieval represents the accessing step of coding.

Decoding. Translating individual letters and/or groups of letters into sounds to access the pronunciation of a word.

Letter-sound correspondence. Linkages between discrete phonemes and individual letters or graphemes.

Lexical access. Access to internal dictionary in memory.

Retrieval. Accessing coded information from short-term or long-term memory.

Memory. Not a unitary ability; types are short-term and long-term; memory processes relevant to reading include encoding, storage, and retrieval (Torgesen, 1985).

Meta-cognitive. Self-awareness of intellectual processes.

Phonological processing. The use of phonology or sounds of language to process verbal information in oral or written form in short- and long-term memory (Wagner & Torgesen, 1987). Components include awareness and coding (i.e., coding sounds for storage in memory and retrieval of sounds from memory codes) of verbal information only (Cornwall, 1992; Hurford et al., 1993; Torgesen et al., 1990; Vellutino & Scanlon, 1987a; Wagner & Torgesen, 1987).

Phonological coding. "The representation of information about the sound structure of verbal stimuli in memory" (Torgesen et al., 1990, p. 236).

Phonological recoding. Translation from either oral or written representation into a sound-based system to arrive at the meaning of words in the lexicon (stored vocabulary) in long-term memory (Wagner & Torgesen, 1987).

Phonetic recoding. Translation of verbal information into a sound-based system for temporary storage in working memory for processes such as decoding unfamiliar words in fluent reading, or during the beginning reading processes of blending and segmenting (Wagner & Torgesen, 1987).

Onset-rime. Two-part division of words into units that are smaller than syllables; onset is the first division of a single phoneme or consonant cluster (e.g.,

/br/ in *bright*), rime is the last division with multiple phonemes (e.g., /ight/ in *bright*).

Phonological units. Refers to the size of the sound (e.g., phonemes, onset-rimes, syllables, word).

Phonemic awareness. Awareness of phonemes, discrete individual sounds that correspond to individual letters. Spector (1995) pointed out that many terms have been proffered for this ability, including phonemic awareness, phonetic analysis, auditory analysis, phonological reading, phonological processing, and linguistic awareness. We will use phonological awareness as a general term and phonemic awareness when specifically referring to awareness at the phoneme level. The distinction between the two terms will be based on the size of the phonological unit.

Representation. Use of arbitrary symbols (oral or written) to represent experience or concepts (e.g., words or graphic symbols like "$").

Word features. Semantic (meaning), syntax (use in sentence or phrase), graphic (letter correspondence to phonemes), and phonologic (sound). Features are used for coding and retrieval.

Chapter Structure

This chapter consists of six sections. First, we discuss five areas of convergence and the varying degrees of support for each area. In areas when the research makes distinctions, we draw attention to similarities and differences between normal achieving and diverse learners. We conclude with a summary of the areas of convergence and discussion of issues, limitations, and extensions of findings. Figure 2 summarizes the organization of the chapter.

Area of Convergence # 1: Phonological Processing Ability Explains Significant Differences Between Good and Poor Readers

One of the most salient findings of the research review was the substantial evidence from numerous lines of research that converged to support phonological processing as the basis for many of the differences in learner characteristics (Adams, 1990; Hurford et al. 1993; Liberman & Shankweiler, 1985; Mann & Brady, 1988; Rack et al., 1992; Spector, 1995; Stanovich, 1985, 1986, 1988; Torgesen, 1985; Torgesen et al., 1990; Vellutino & Scanlon, 1987, 1987a; Wagner, 1986, 1988; Wagner & Torgesen, 1987). The multiple perspectives represented by these lines of research (e.g., assessment for early identification of reading problems, causal relations between phonological processing and reading acquisition, longitudinal correlational studies, training of phonological awareness) further support the strength of the convergence.

In this section, we delineate the components of phonological processing and discuss their differential relation to normally achieving and diverse learners. Because of the highly technical language, selective definitions are embedded to facilitate understanding.

Components of Phonological Processing

Extensive research has examined whether phonological processing is a general ability or a compilation of independent abilities (e.g., Wagner & Torgesen, 1987). Based on their review of phonological processing research, Wagner and Torgesen (1987) proposed a partial answer: To some degree, phonological ability is general across tasks. This conclusion is based on significant interrelations among the component abilities. However, Wagner and Torgesen (1987) also concluded that there is an empirical basis for separating one component, awareness, from another component, coding (i.e., coding and retrieval). Similarly, several lines of research provide strong support that phonological processing includes two broad dimensions, coding and awareness (Hurford et al., 1993; Liberman & Shankweiler, 1985; Mann & Brady, 1988; Wagner & Torgesen, 1987), each with multiple

dimensions. See Figure 3 for a summary of the dimensions of phonological processing and respective components.

Coding. Researchers have isolated two dimensions of coding: phonetic and phonological (Liberman & Shankweiler, 1985; Vellutino & Scanlon, 1987a; Wagner & Torgesen, 1987). Both dimensions include multiple processes that require memory and coding from one form of representation to another (e.g., written to sound units for memory). The distinction between the two coding dimensions is type of memory. That is, phonetic recoding takes place in short-term memory for such processes as sounding out unfamiliar words. In contrast, phonological recoding accesses the lexicon in long-term memory for known words in a three-step process. First, written symbols are recoded to the pronunciation of the written word. Second, the pronunciation of the written word is matched with the pronunciation of words in memory. Third, pronunciations of words in memory are linked with meaning for retrieval of meaning and pronunciation (Wagner & Torgesen, 1987). In examining reading disabilities, research looks at:

1. What features of words are used in different types of memory?
2. Is the quality of encoding different for normally achieving and diverse learners, and if so, in what way?
3. Which is problematic for diverse learners, storage capacity or quality of original encoding? (Torgesen, 1985)

Awareness. Phonological awareness is a general ability with multiple dimensions, which uses a single modality, auditory. Thus, it is the ability to hear sounds in spoken words in contrast to recognizing sounds in written words, which involves the other phonological processing dimension, coding. Phonological awareness is an inclusive term, referring to all sizes of sound units, such as words, syllables, onset-rimes, and phonemes. Phonemic awareness, however, refers only to the phoneme level. Awareness is less complex than coding in the demands it puts

on memory and processing. In addition, our review indicated that phonological awareness is relatively independent of overall intelligence, a finding of particular relevance for diverse learners (Torgesen, 1985; Vellutino & Scanlon, 1987; Wagner & Torgesen, 1987).

Relations Between Phonological Processing and Learner Characteristics

Several lines of research provide convincing evidence that phonological processing deficits cause differences in perceiving, coding, remembering, and retrieving verbal information between normal achievers and students with normal intelligence and reading disabilities (Liberman & Shankweiler, 1985; Mann & Brady, 1988; Rack et al., 1992; Stanovich, 1985, 1986, 1988; Torgesen et al., 1990; Vellutino & Scanlon, 1987a; Wagner, 1988; Wagner & Torgesen, 1987). Characteristics of diverse learners who experience difficulties specific to reading that are not attributable to an overall lower level of achievement or cognitive ability were examined across all the studies cited. In contrast, comparisons of poor readers with normal intelligence and general lower cognitive ability were examined in few studies (e.g., Hurford et al., 1993; Stanovich, 1988). Therefore, much of our discussion is specific to students with normal intelligence and reading disabilities and good readers.

In the second area of convergence, we discuss learner characteristics differences in phonological awareness; therefore, the discussion in the present section is limited to differences in coding and memory. Converging evidence supported the notion that the phonological features of language were problematic for a significant number of diverse learners (Cornwall, 1992; Torgesen et al., 1990; Vellutino & Scanlon, 1987, 1987a; Wagner, 1986). Four types of evidence indicated differences between normally achieving and diverse learners' skills in coding phonologic features that also affected memory: (a) memory span (verbatim retention of new strings of verbal items); (b) recall of verbal information (in contrast to recall of nonverbal items such as abstract figures); (c) articulation rate (how

quickly words are spoken); and (d) rapid naming (verbally labeling familiar material) (Cornwall, 1992; Torgesen, 1985; Torgesen et al., 1990).

All learners. The finding that differences were specific to type of information suggested that learners were not different in memory capacity (Torgesen, 1985). Hypothesized explanations that short-term memory is limited for everyone suggested the importance of efficiency of processes because of limitations (Mann & Brady, 1988). No differences were found in recall of nonverbal items, such as drawings of figures, or in accuracy of nonverbal material, such as environmental sounds like frogs croaking (Mann & Brady, 1988; Torgesen, 1985).

Diverse learners. The following differences suggested that the ability to code phonological features is problematic for diverse learners. For example, we know that newly presented information is encoded in short-term or working memory by phonological features (Torgesen, 1985). When asked to repeat strings of digits or objects that are new to them, diverse learners respond less quickly and accurately (Cornwall, 1992; Torgesen et al., 1990), suggesting problems with the initial coding process. The literature infers that poor recall indicates either an absence of coded material available for recall or a poor quality code (Mann & Brady, 1988; Torgesen, 1985). Rapid naming tests have indicated that even when students understood the material, diverse learners' rate at rapid naming was slower; in other words, the problem was rate of naming familiar material not comprehension, which suggested either a problem in recoding information in long-term memory to its phonological features for pronunciation and/or problems in retrieving poorly coded material (Katz cited in Mann & Brady, 1988). For example, error analysis found that students would incorrectly name a picture with a word similar in phonological structure to the correct word. Katz hypothesized that the object had been correctly identified and understood but that difficulty occurred in phonetically producing the word (Katz cited in Liberman & Shankweiler, 1985). In addition, diverse learners' slower rates

of articulation draw attention to lack of fluency with phonological features of language (Torgesen et al., 1990).

Differential use of word features for coding is suggested by tasks using phonological and semantic distracters, tasks measuring familiar and nonsense groups of letters, and error analysis for recall of lists of spoken words (Mann & Brady, 1988; Torgesen, 1985; Vellutino & Scanlon, 1987, 1987a). In contrast to good readers, poor readers (a) were not more distracted by phonologically similar words implying less sensitivity to phonological features, (b) categorized words on the basis of semantic features more than phonological features, (c) performed equally on nonsense words in contrast to good readers who performed better on familiar words, and (d) did use phonetic codes in recalling lists of spoken words by attending to similar phonological features in adjacent words; however, they were less efficient than good readers (Mann & Brady, 1988, Torgesen, 1985; Vellutino & Scanlon, 1987, 1987a). Thus, differences between normally achieving and diverse learners were specific to the linguistic material presented and their use of the phonological features of words in encoding, storage, recoding, and retrieval. Differences were not specific to syntax and comprehension; however, in addition, diverse learners did make more use of semantic features in categorizing words than phonological (Vellutino & Scanlon, 1987a).

Summary

Phonological processing consists of two components, awareness and coding, each having multiple dimensions that are relevant to reading acquisition. Explanations for differences between normally achieving and diverse learners in the ability to code, remember, and retrieve verbal information suggested the following causal chain (Liberman & Shankweiler, 1985; Mann & Brady, 1988; Torgesen, 1985):

IF *poor perception* THEN *poor quality of representation or coding*

IF *poor coding* THEN *poor durability in storage*

IF *poor durability in storage* THEN *poor retrieval*

The research indicated that differences were specific to linguistic material. Our first area of convergence, that phonological processing (awareness, coding, and retrieval) is the basis for many differences in learner characteristics, has provided the larger context for our second area of convergence, where we explore the dimensions of phonological awareness.

Area of Convergence # 2:

Phonological Awareness Is a General Ability with Multiple Dimensions

Phonological Awareness as a General Ability

As the study of phonological processing advances, research has shifted from the global concept of phonological processing to the more sophisticated examination of phonological awareness. The question whether phonological awareness is a general ability or a collection of independent but related abilities has received increasing attention over the last decade (e.g., Lenchner et al., 1990; O'Connor et al., 1993). Our review of the available evidence provides moderate support that phonological awareness is a general ability with multiple dimensions of varying complexity (Lenchner et al. 1990; O'Connor et al., 1993; Spector, 1995; Vellutino & Scanlon, 1987; Wagner, 1986; Wagner & Torgesen, 1987; Yopp, 1988).

Support for a "general ability" theory stems from the high degree of interrelatedness among dimensions of phonological awareness in the following types of studies: (a) causal model, (b) reliability and validity of dimension measures, (c) predictors of reading, and (d) training (e.g., O'Connor, 1993; Wagner & Torgesen, 1987; Yopp, 1988). This degree of interrelatedness means that the dimensions shared significant commonality and tapped a similar construct (Yopp, 1988).

Despite moderate support of phonological awareness as a general ability, a number of important issues remain unresolved. First, Lenchner et al. (1990) drew attention to the relatively few studies focusing on whether or not tasks measure an

underlying single ability. Second, Wagner's (1988) meta-analysis indicated differential relations dependent on the measure of reading. Thus, Wagner found that two dimensions of awareness, blending and segmenting, did not have independent causal relations with word recognition (linking pronunciation with meaning) but did for word analysis (taking apart phonological units in words). Third, Lenchner et al. (1990) indicated that the way the dimensions relate to each other may represent more independence than we now propose, specifically the varying strengths of relations among phonological awareness tasks may not support a general ability theory.

Wagner's meta-analysis (1988) suggested that segmentation and blending tap a single latent ability. Similarly, a later study partially confirmed the "implicit hypothesis" that blending and segmenting are highly related (Lenchner et al., 1990). Specifically, Lenchner et al. (1990) refined earlier positions about the relation between segmentation and blending, concluding that the tasks measure similar but not identical processes. Similarly, Byrne and Fielding-Barnsley (1989) found that detection of common phonemes and segmenting are to some degree independent of each other. In that study, all students who could detect could also segment; however, some could segment but not detect.

Last, in contrast to the documented relations among segmenting, blending, and detection, rhyme is weakly related with other phonemic tasks. Moreover, because of the less strong relation among rhyme and other phonemic awareness tasks, Yopp (1988) concluded that rhyme may tap a different underlying ability and, therefore, cautioned against basing phonological awareness on rhyme.

Nevertheless, given the moderate agreement that phonological awareness is a general ability comprised of multiple dimensions, we next discuss those dimensions of phonological awareness, issues related to assessment, and issues related to phonological awareness performance across learner ability.

Dimensions of Phonological Awareness

Research has shown that phonological awareness dimensions can be validly and reliably measured through a variety of tasks (Wagner, 1986; Yopp, 1988). The following tasks have been used in recent research as indicators of phonological awareness: auditory discrimination, blending, counting, deletion, isolation, rhyme, segmenting, substitution, sound categorization, tapping, reversing order of sounds, and word to word matching (Ball & Blachman, 1991; Lundberg et al., 1988; O'Connor et al., 1993; Spector, 1995; Yopp, 1988).

Several dimensions of phonological awareness received considerable attention in the research reviewed. Among the dimensions identified, segmentation was the most frequently used. It was often paired with other dimensions: including blending (Cunningham, 1990; O'Connor et al., 1993); detection (Byrne & Fielding-Barnsley, 1989; Hurford et al., 1993); and invented spelling (Mann, 1993). In studies of older readers, segmenting was used in combination with rapid naming and list learning skills (Cornwall, 1992) and with deletion (Lenchner et al., 1990).

Range of Difficulty

A continuum represents dimensions of a whole or underlying ability rather than a series of discrete or independent units. We use a continuum to illustrate that the dimensions of phonological awareness are represented by a range of difficulty. From easiest to hardest the range of difficulty is as follows: (a) rhyme, (b) auditory discrimination, (c) phoneme blending, (d) word-to-word matching, (e) sound isolation, (f) phoneme counting, (g) phoneme segmentation, and (h) phoneme deletion (Yopp, 1988). Figure 4 diagrams this range.

Factors That Affect Difficulty

Two factors often contribute to difficulty related to phonological awareness: the memory requirements of the task and the characteristics of phonological units.

The characteristics we consider are (a) position in word, (b) degree of abstraction, (c) size, and (d) phonological properties. Phonological awareness tasks vary in the number of steps required for completion. Each step requires material to be held in memory. For example, phonemic awareness tasks were divided into two categories based on the memory processes and operations required: (a) one operation of verbal material followed by response, as in segmentation; and (b) one operation followed by holding the response to that operation in memory while performing other operations before making the final response, as in deletion (Yopp, 1988). For example:

> When asked what sounds are heard in fish (segmentation), the response requires one step of pulling apart sounds: /f/ /i/ /sh/
>
> When asked to delete the first sound from fish, the response requires two steps. First, identify the beginning sound and segment the sounds. Second, the remaining sounds need to be held in memory and then blended.
>
> fish /i/ /sh/, ish

A number of characteristics of phonological units have been found to affect difficulty including: (a) the position of the phonological unit in the word (i.e., first, middle, or last); (b) degree of abstraction; (c) size of sound unit; and (d) phonological properties of the phoneme(s). Research points to the differential difficulty for initial, medial, and final positions, with initial and final positions easier than middle (Byrne & Fielding-Barnsley, 1989; Lie, 1991; Mann & Brady, 1988, Spector, 1995).

Likewise, degree of abstraction, or degree of meaning, affects difficulty. A intervention study (Lundberg et al., 1988) illustrated such attention to degree of abstraction. The sequence began with segmentation of words from idea units in sentences because words have meaning and are large, usually naturally (i.e., without instruction) recognized phonological units. The teaching sequence ended with the least natural and most abstract phonological unit, segmenting phonemes in a word.

In our discussion of the range of difficulty, we focus on the smallest phonological unit, phonemes, for three reasons. First, our review indicated that phonemes bear a critical relation to beginning reading (Wagner, 1988). Second, research indicated that the processes at the phoneme level did not develop naturally or easily without instruction (Liberman & Shankweiler, 1985). Third, the relation between phonological processing characteristics of diverse learners and characteristics of phonemes is problematic (Cornwall, 1992; Rack et al., 1992; Spector, 1995; Torgesen, 1985; Vellutino & Scanlon, 1987, 1987a). In short, phonemes are difficult to perceive because of the following characteristics: They are: (a) the smallest phonological unit, (b) not acoustically pure, (c) independent of meaning in isolation, and (d) abstract and arbitrary.

Several intervention studies and reviews focused attention on the relative difficulty of phonological properties. For example, Lie (1991) examined the phonological properties and complexity of task by manipulating continuant sounds, stops, and blends. Other researchers have investigated the combined effects of phonological properties of tasks. For example, Spector (1995) conjectured that differential difficulty between phonemes and syllables (i.e., size) can in part be explained by their differential acoustical properties. Spector (1995) explained that we do not hear discrete pure phonemes because they overlap; rather, we hear in syllables. Therefore, tasks that require identifying, moving, and combining phonemes may be more complex and necessarily more difficult than those that require manipulation of syllables.

Important Features of Assessment

A range of measures have been used to assess phonological awareness ability, the integrity and utility of which are subject to a variety of issues and influences. The relation between tasks and phonological awareness ability must be examined according to the technical soundness of the measures. We outline the importance of

three assessment features: representativeness of entire range of difficulty, reliability, and validity.

Discussion emerged in the literature whether current assessment tools measure the entire range of phonological awareness dimensions that exist at varying ages and involvement with reading (e.g., Lenchner et al., 1993; O'Connor et al., 1993). For example, when the majority of students in a study either failed or passed a phonological awareness measure, the question became, is there an easier or more difficult dimension of phonological awareness that is not being assessed relevant to the aspect of reading being examined? Reliable measures are consistent across measurement conditions. Yopp's (1988) study provided a critical framework for evaluating findings from phonological awareness measures. Her study clearly indicated the existence of a range of reliability for measures. For example, two specific tests were nearly 100% reliable (i.e., a blending test and a segmenting test). Combinations of tests had greater and significant predictive validity (i.e., predicted how phonological awareness relates to a measurable reading skill) for beginning reading than single tests (Yopp, 1988).

Our understanding of phonological awareness has advanced with the measures used. Because measures only indicate rather than measure directly, it is critical to remember that what we know is both defined and limited by our measures. Moreover, it is important to note the small number of phonological awareness studies with older readers. In this review, we examined two primary studies (Cornwall, 1992; Lenchner et al., 1990) and Vellutino and Scanlon's research with older readers (1987, 1987a). In addition, reviews of the causes of reading disabilities generally referred to research across ages (e.g., Rack et al., 1992; Snowling, 1991).

A Factor That Affects Performance

Research on the development of phonological awareness provides another method of differentiating simple from more difficult tasks (Adams, 1990; Liberman & Shankweiler, 1985; Mann & Brady, 1988). In particular, we can infer the relative complexity of other dimensions, such as rhyme, from developmental work which indicates that most young children can rhyme but not delete (Adams, 1990). Further, for the majority of children, syllable segmentation is easier and often develops without instruction, in contrast to phoneme segmentation. For example, in groups of four-year-old children, none could segment by phoneme whereas about 50% could segment by syllables; in a group of five-year-olds, 17% could segment by phoneme and about 50% could do so by syllable. Finally, in a group of six-year-old children, 70% could segment by phoneme and 90% by syllable (Liberman & Shankweiler, 1985).

Summary

In conclusion, our review of the available evidence provides moderate support that phonological awareness is a general ability that has multiple dimensions varying in difficulty (O'Connor et al., 1993; Spector, 1995; Wagner & Torgesen, 1987; Yopp, 1988). Moreover, those dimensions can be reliably and validly measured (Yopp, 1988). Figure 4 diagrams the range of difficulty from easiest (rhyme) to hardest (deletion). Two factors that contribute to difficulty are the memory requirements of the task and the characteristics of the phonological units. The following characteristics received consistent attention in the literature: (a) position of the phonological unit in the word (i.e., first, middle-the most difficult, last); (b) degree of abstraction; (c) size of sound unit; and (d) phonological properties of the phoneme(s). Finally, developmental studies indicated that the more difficult dimensions usually did not develop without instruction, in contrast to the easiest dimension, rhyme. Unpacking the relative difficulty of phonological awareness

dimensions serves as a framework for the next section in which we discuss the role that phonological awareness plays in beginning reading.

Area of Convergence # 3: Phonological Awareness Has a Reciprocal Relation to Reading Acquisition

Hypothesized Relations

Our review indicated a range of hypothesized relations between phonological awareness and learning to read. Specifically, phonological awareness has been hypothesized to be: (a) a prerequisite for learning to read, (b) influenced by reading instruction and practice, and (c) both a cause and a consequence of reading acquisition (i.e., reciprocal). The importance of establishing the relation between phonological awareness and reading acquisition is the differential implications of each relation for the timing and content of instruction. For example, if evidence provides powerful support for a causal relation, then phonological awareness training prior to formal reading instruction is implied. However, if the evidence supports the hypothesis that it is formal reading instruction itself that develops phonological awareness, the timing and instructional sequence issues are reversed. In addition, if phonological awareness develops as a consequence of reading, then the critical importance of phonological practice in connected text and the amount of reading in which each student engages is strongly implied. If evidence establishes that phonological awareness is necessary before reading instruction begins and that phonological awareness is also developed by specific types of instruction, emphasis on phonological awareness before and during beginning reading instruction is firmly established. Under both conditions, phonological awareness would foster reading acquisition.

In this area of convergence, we first review the strength of evidence for a causal relation between phonological awareness and reading acquisition. Next, we present evidence from the secondary sources (e.g., studies with readers of varying

ages and ability) that phonological awareness also develops as a consequence of reading instruction. Then, we examine support for a reciprocal relation provided by causal and consequence of instruction evidence. Last, we consider limitations of the importance of the relation between phonological awareness and reading acquisition.

Causal Relation

Over the past decade, growing support for a causal relation between phonological awareness and reading acquisition has been evidenced in the language used in research conclusions. For example, articles appearing in 1985 used tentative language stating that phonological awareness may improve reading acquisition (Liberman & Shankweiler, 1985) and there is mounting evidence that the relationship is causal (Stanovich, 1985).

In contrast, more recent reviews specifically concluded that converging evidence is sufficiently strong to establish a causal relationship (Mann & Brady, 1988; Wagner, 1988; Wagner & Torgesen, 1987). Moreover, our review of secondary sources provided consistent evidence for a strong causal relation between phonological awareness and learning to read (e g., Adams, 1990; Liberman & Shankweiler, 1985; Mann & Brady, 1988; Rack et al., 1992; Spector, 1995; Stanovich, 1985, 1986, 1988; Wagner, 1988).

We examine support for the causal relation by examining evidence from the following types of study: (a) correlational, (b) experimental intervention, and (c) comparisons of good and poor readers.

Correlational studies. Two general purposes categorize the correlation studies reviewed: predicting later reading achievement and understanding the relations among aspects of reading and dimensions of phonological awareness. First, predictive studies compared the relation between phonological awareness at an earlier age with subsequent reading achievement at a later age, for the purpose of discovering correlations between phonological awareness and reading. If consistent

and strong correlation was found, then phonological awareness would predict later reading achievement.

Our review revealed that phonological awareness reliably predicted reading achievement across the age levels of participants from preschool through sixth grade (Cornwall, 1993; Hurford et al., 1993; Mann, 1993). Alone, the predictive evidence does not establish causal relation because other variables may be the explanatory factor. However, powerful evidence for a causal relation results when predictive findings with high validity are combined with highly significant effects of beginning reading measures in intervention studies prior to formal reading instruction (Wagner, 1988).

Second, the relation between phonological awareness and reading was documented by two statistical methods for analyzing data, path analysis and factor analysis. Path analyses have indicated that various dimensions of phonological awareness are related differentially to reading. In addition, analyses indicated that blending and segmenting phonemes are more highly related to reading than blending and segmenting syllables (Wagner, 1988; Wagner & Torgesen, 1987).

The significance of correlational studies are twofold: First, the power of phonological awareness to predict reading achievement enables early identification of students at risk for difficulty in learning to read (Hurford et al., 1993; Mann, 1993). Second, differential information about the interrelations among phonological abilities (i.e., awareness, coding, and retrieval), specific subskills for reading, and age of children teach us much about the nature of the reading process itself and reading disabilities (Stanovich, 1988; Vellutino & Scanlon (1987a).

Intervention studies. Intervention studies provided a second source of support for a causal relation between phonological awareness and reading (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1990; Cunningham, 1990; Lie, 1991; Lundberg et al., 1988; O'Connor et al., 1993; Vellutino & Scanlon, 1987). Wagner and

Torgesen (1987) noted that if training in phonological awareness improves subsequent reading, it is reasonable to infer a causal relation.

In this type of study, the effect of phonological awareness instruction on subsequent phonological awareness development, reading, and possibly spelling achievement was assessed with pre- and posttest comparisons of achievement. Phonological awareness instruction had a significant influence on subsequent measures in all intervention studies reviewed; however, the strength of conclusions varied.

Comparisons of good and poor readers studies. Vellutino and Scanlon's work of more than a decade comparing poor second- and sixth-grade readers to good second- and sixth-grade readers (1987a) is particularly noteworthy. Their work with good and poor readers indicated that the ability to grasp phonemic segmentation is a prerequisite for linking sounds to corresponding letters and subsequent word identification, and that poor readers were able to profit from phonemic segmentation training with positive effects on ability to identify words. These authors concluded that facility of phonemic segmentation is causally related and not simply a consequence of reading. Other researchers in our review who examined differences between good and poor readers reached the same conclusion across ages and various alphabetic languages (e.g., Adams, 1990; Lenchner et al., 1990; Rack et al., 1992; Stanovich, 1985, 1986, 1988).

In summary, multiple research perspectives add converging evidence that strongly supports a causal relation between phonological awareness and reading acquisition. Next, we present evidence that phonological awareness is developed by reading instruction and reading.

Phonological Awareness As a Consequence of Reading Instruction and Practice

Establishing a causal relation between phonological awareness and reading acquisition does not preclude other directional relations (e.g., reading instruction

causes phonological awareness development). Our review produced limited but converging evidence that phonological awareness is developed by reading instruction and the act of reading. Evidence came from three sources: (a) reviews of studies with skilled readers in nonalphabetic languages, (b) review of studies with adult illiterates in alphabetic languages, and (c) one primary study.

First, studies that found skilled adult readers in nonalphabetic languages were deficient in phonemic segmentation (Adams, 1990; Mann & Brady, 1988) inferred support because nonalphabetic languages do not include phonological awareness instruction. Second, studies in alphabetic languages that focused on adult illiterates indicated that those who successfully completed literacy programs had higher levels of phonological awareness than those who did not (Adams, 1990; Mann & Brady, 1988). Support for the consequence relation is inferred from the higher levels of phonological awareness among adults receiving more instruction and practice by finishing the program compared to those who did not finish. Last, one primary study in our review (Hurford et al., 1993) with normal achievers and two types of diverse first-grade readers concluded that the process of reading increased reading and phonological awareness across ability (i.e., normally achieving, normal intelligence and reading disability, low intelligence and reading disability).

Finally, although Wagner and Torgesen (1987) indicated that learning to read is a nontrivial cause in the development of phonological awareness; they indicated the effect of instruction and practice on phonological awareness has not received much research attention (see also Mann & Brady, 1988; Wagner, 1988).

Reciprocal Relation

We conclude that limited support for the hypothesis that reading instruction and practice causes phonological awareness combined with strong support for the hypothesis that phonological awareness is a causal factor in reading acquisition suggests a reciprocal relation: phonological awareness facilitates and is influenced by

reading acquisition. The existence of a reciprocal relation means that phonological awareness is important prior to and during learning to read.

The practical importance of the reciprocal relation between reading and phonological development has been argued extensively and passionately by several authors (e.g., Adams, 1990; Stanovich, 1985; Vellutino & Scanlon, 1987a; Wagner & Torgesen, 1987). Similarly, our review found consistent recommendations for early identification of students at-risk for reading failure (e.g., low ability in phonological awareness) and early, explicit instruction in phonological awareness prior to and in tandem with beginning reading instruction (e.g., Ball & Blachman, 1991; Cunningham, 1990; O'Connor et al., 1993).

Limited Importance of Relation

Several authors pointed to heterogeneous causes for reading disabilities and the subsequent dangers of focusing on one intervention target such as phonological awareness (Snowling, 1991; Stanovich, 1988; Wagner, 1986). The seven intervention studies in our review indicated that instructional implications are inherent in the relations between phonological awareness and reading acquisition. In contrast, although differences in visual and phonological processing abilities appear to offer some explanations for reading disabilities, the instructional implication of those relations are not as clear as those of phonological awareness (Snowling, 1991; Torgesen, 1985; Wagner, 1988). Nevertheless, attention to a larger research focus (i.e., relations among awareness, phonetic recoding, phonological recoding and their covariation with reading) is important because this research may help explain why not all children respond to phonological interventions (Vellutino & Scanlon, 1987a; Wagner & Torgesen, 1987).

For example, roughly one third of our primary studies included examinations of the relations between coding and reading acquisition (Cornwall, 1992; O'Connor et al., 1993; Torgesen et al., 1990; Vellutino & Scanlon, 1987). Conclusions from these

studies pointed to the need for future research to examine instruction in rapid naming and list learning. For example, interaction of several independent processes (i.e., deletion, naming, and list learning) may determine the extent and severity of reading problems. Moreover, the interrelation of awareness and two types of coding (naming and list learning) may relate to automaticity (Cornwall, 1992). Similarly, two studies suggested that naming speed may be a critical component in learning to read successfully (O'Connor et al., 1993; Torgesen et al., 1990).

Summary

The critical relation of phonological awareness to reading acquisition appears firmly established, the evidence for a causal relation being strong. Since fewer studies exist for older children, our evidence for the effect of learning to read on phonological awareness is more limited. Nevertheless, the combination of conclusions from studies with older children with the secondary sources that suggested an effect of reading on phonological awareness development strongly suggests the existence of a reciprocal relation.

A causal relation implicates the timing and content of beginning reading instruction. It is critical, therefore, to understand the relative importance of instruction in phonological awareness throughout reading instruction. In the next area of convergence, we discuss evidence of the sufficiency of phonological awareness alone in learning to read.

Area of Convergence # 4: Phonological Awareness Is Necessary But Not Sufficient

A sizeable body of research indicates causal and reciprocal relations between phonological awareness and reading acquisition. In this section, we review research that has examined the role and relation of phonological awareness to alphabetic understanding (Adams, 1990; Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1989; Spector, 1995; Stanovich, 1985; Vellutino, 1991; Vellutino & Scanlon, 1987a),

and the role and relation of coding linguistic material into phonological codes to automaticity (Cornwall, 1992; O'Connor et al., 1993; Torgesen et al., 1990; Vellutino & Scanlon, 1987). Findings are described in terms of the relation among the characteristics of diverse learners and their subsequent needs in instruction.

Phonological Awareness and Alphabetic Understanding

Phonological awareness involves the ability to hear and manipulate sounds. Though research has established its importance, the way phonological awareness relates to and promotes other processes of reading acquisition requires further unpacking. Specifically, what is the relation and role of phonological awareness in alphabetic understanding? Alphabetic understanding refers to understanding that letters represent sounds and that whole words embody a sound structure of individual sounds and patterns of groups of sounds. The alphabetic principle is the combination of alphabetic understanding and phonological awareness. The alphabetic principle facilitates reading because readers cannot access words in their own internal dictionaries (lexicon) if they are unable to pronounce the words. Thus, the alphabetic principle enables the reader to translate independently a visual symbol into a sound, or as Spector expressed, to be able to crack the code by "mapping letters to sound" (1995, p. 7) or to decode. This independence is in contrast to beginning readers who may depend upon someone else saying the word that the letters represent (Adams, 1990; Spector, 1995).

Instruction in Phonological Awareness and Letter-Sound Correspondences

Converging evidence provided strong support that a combination of phonemic awareness and letter-sound correspondence training is necessary to understand the alphabetic principle (Adams, 1990; Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1990; Mann, 1993; Rack et al., 1992; Snowling, 1991; Spector, 1995; Stanovich, 1986; Vellutino, 1991; Vellutino & Scanlon, 1987a). In the intervention studies reviewed, several examined combinations of phonological awareness and

letter-sound correspondences (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1989; Cunningham, 1990; O'Connor et al., 1993), whereas only two exclusively taught phonological awareness abilities (Lie, 1991; Lundberg et al., 1988). We use two representative studies to illustrate the evidence.

First, the results of a intervention study with kindergartners clearly indicated that phonemic awareness and letter-sound correspondence significantly enhanced later reading and spelling performance more so than training in letter-sound correspondence alone (Ball & Blachman, 1991). Similarly, in teaching young preliterate children to acquire the alphabetic principle, Byrne and Fielding-Barnsley (1989) found that only those who learned phonemic segmentation and phoneme identification skills and graphic symbols for initial sounds were able to correctly choose between *mow* and *sow* after they had been taught *mat* and *sat*.

A third study examined the effects of a meta-cognitive component on phonological awareness and letter-sound correspondence instruction with kindergarten and first grade children (Cunningham, 1990). The study compared two instructional approaches across kindergarten and first grade: (a) letter-sound correspondence and skill training in phonemic awareness, and (b) letter-sound correspondence, skill training, and instruction in strategic use of phonemic awareness skills in context of reading. Adding explicit instruction in strategic application of the skills to instruction in letter-sound correspondence and skill training in phonological awareness resulted in significant improvement in reading. Specifically, improvement was noted in letter-sound correspondence knowledge, word recognition, and reading comprehension. Cunningham (1990) concluded that the difference was explained by contextualized instruction that included (a) instruction in and demonstration of conspicuous strategies, (b) guided practice, and (c) strategic and purposeful review of previous lessons in addition to the combination of phonemic awareness and letter-sound correspondence instruction.

Coding and Automaticity

Coding involves translating stimuli from one form to another (e.g., from auditory to written or from written to auditory), whereas automaticity has to do with the quality (i.e., fluency) of the response, or the quality of coding. Our understanding of the relation between fluent coding (phonological processing) and reading acquisition is limited by the amount of the available phonological processing research, specifically training research. Wagner and Torgesen (1987) drew attention to the need for extending phonological awareness research to include phonological processing. Such an extension would attempt to better understand the interaction between processing and awareness for different reading ability levels.

Since 1987, a new line of research has been emerging that suggests rapid letter naming and list learning abilities may significantly affect ease of reading acquisition (Cornwall, 1992; O'Connor et al., 1993; Torgesen et al., 1990; Vellutino, 1991; Wagner, 1988; Wagner & Torgesen, 1987; and recent studies not part of our review). Rapid letter naming and list learning are two tasks commonly used to measure ability to code material into phonological representations (refer to second area of convergence in this chapter for explanation of coding). We use two primary studies with nonreaders and older readers to illustrate the trend in research to examine the relations among awareness, coding, and reading acquisition.

First, although phonological awareness was the primary research focus in a study with nonreaders, significant differences on reading and spelling measures between low- and high-skilled children could be explained by differences in rapid-letter-naming (O'Connor et al., 1993). It is important to note that the children did not receive instruction to increase rate (speed). Because the phonological awareness performance of the low-skilled children was brought to the level of the high-skilled children with instruction, it is reasonable to wonder whether instruction designed

to increase speed would affect reading and spelling achievement for low-skilled children also.

Second, a study with older readers investigated the predictive relations of phonological awareness, naming speed (phonological recoding), and list learning (phonetic recoding) with reading and spelling (Cornwall, 1992). Students that had rapid rates of letter naming did better in word identification and prose passage reading speed and accuracy than students with lower rates of rapid naming. In contrast, list learning ability predicted only word identification.

Like O'Connor et al. (1993), Cornwall (1992) linked naming and list learning to automaticity. In addition, Cornwall (1992) suggested that relative differences in naming and list learning may impact ability to learn and recall alphabet letters. Thus, teaching skills of rapid naming of verbal material and memorizing lists (such as the alphabet) may be significant additions to instructional combinations. However, much remains to be known about the practical features of instruction.

Summary

The complexity of the reading process in the roles played by phonological awareness and coding in reading acquisition and disability is made clear by the range of studies. Findings suggest that a single approach to understanding the reading process is inadequate (e.g., Adams, 1990; Snowling, 1991; Stanovich, 1985; Vellutino & Scanlon, 1987, 1987a). Vellutino's (1991) conclusion that research supports a comprehensive and balanced approach is echoed in the research we reviewed. Research supported combining phonological awareness instruction with letter-sound correspondence instruction and instruction that makes clear the utility of the alphabetic principle in the context of reading. Recent research suggests that instruction in rapid naming and list learning may be critical components of beginning reading instruction, specifically for diverse learners. Next, we conclude with evidence that phonological awareness can be taught with significant gains in

subsequent reading and spelling achievement for all learners as our final area of convergence.

Area of Convergence # 5: Phonological Awareness Is Teachable and Promoted by Attention to Instructional Variables

We frame our discussion of the final area of convergence, phonological awareness is teachable and promoted by attention to instructional variables, with the following six-part structure. First, we give an overview of the seven intervention studies and their effects. Then, we examine the components of effective instruction. In addition, we identify significant independent variables found in only one or two studies and, therefore, supported by limited evidence. Fifth, we discuss the interaction of variables with specific learner characteristics. Finally, our summary provides instructional implications of the fifth area of convergence.

Overview of Studies

Our review examined research published since 1985; therefore, this fifth area of convergence is from a selective, but nevertheless representative analysis and synthesis of seven studies of the effects of phonological awareness interventions on the phonological awareness development, reading, and spelling acquisition of normally achieving students and diverse learners (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1990; Cunningham, 1990; Lie, 1991; Lundberg et al., 1988; O'Connor et al., 1993; Vellutino & Scanlon, 1987). In addition to primary studies, we included one secondary source that reviewed phonological awareness training literature (Spector, 1995).

Across the studies, age, student ability, and reading ability were frequently investigated as demographic and explanatory variables. Normal achievement was examined in all studies and was also the focus of more than half the intervention studies, unlike disabilities or delays which were the focus of only one study. Five of

the seven studies involved nonreaders, two focused on students in beginning reading instruction. A large gap exists in intervention studies for older students with reading disabilities (Spector, 1995); a single intervention study looked at older readers (i.e., second- and sixth-grade children, in Vellutino & Scanlon, 1987). Further underscoring the research emphasis on younger children found in our review, only two primary correlation studies involved older children. Therefore, the instructional implications drawn from the intervention studies reviewed are most relevant for normally achieving children prior to and concurrent with beginning reading instruction.

Participants' ages ranged from preschool through sixth grade; the average age was kindergarten and first graders. Normally achieving children and children with identified intelligence, language, and phonological awareness disabilities or delays were studied. Five studies used English-speaking students. Non-English speaking children in Scandinavian countries were participants in two studies (Lie, 1991; Lundberg et al., 1988). The length of interventions varied from a few days (e.g., 5 days) to a year. Length of sessions varied from 10 to 30 minutes and ranged in frequency from daily to twice a week. Roughly 70% of the studies had an average of 15 minutes of instruction three times a week for nine weeks.

Effects of Phonological Awareness Instruction

The effects of teaching phonological awareness were among the most instructionally salient findings in our review of intervention studies. Thus, all seven studies reported positive effects on reading, spelling, or phonological awareness development. Six of the seven studies pointed to significant effects on various measures of phonological awareness, reading, or spelling. All studies looked at effects on reading; roughly 80% looked at effects of phonological awareness instruction on subsequent phonological awareness development, whereas roughly 60% looked at effects on spelling.

In addition to those short-term effects, two studies reported positive long-term transfer effects on reading and spelling and long-term maintenance effects on phonological tasks spanning one to two years (Lie, 1991; Lundberg et al., 1988). Long-term maintenance means that the effects were evident when measured again long after the intervention stopped. Three studies reported differential effects of phonological awareness training (Lie, 1991; Lundberg et al., 1988; O'Connor et al., 1993). For example, Lundberg et al. (1988) noted larger effects of phonological awareness training on segmentation than on tasks requiring rhyming. Particularly pertinent for our purposes were the greater effects for diverse learners (Lie, 1991) and the significant facilitation of reading acquisition for diverse learners and normally achieving children in studies that compared both types of learners (O'Connor et al., 1993; Vellutino & Scanlon, 1987).

Components of Effective Instruction

We found consistent attention to the following components across the intervention studies.

1. Student's mental manipulations of sounds were made overt with concrete representation of sound.
2. Individual sounds were orally modeled by the teacher and produced by student.
3. Explicit instruction was specifically recommended by researchers.
4. Letter-sound correspondence component was added to phonological awareness interventions.
5. The dimension of segmenting or combinations of segmenting, blending, and detection received focus.
6. Linguistic complexity was scaffolded.

Concrete representation. Utilization of concrete representation of sound was an instructional feature of all studies with the exception of Lie (1991). Concrete

representation involves using neutral objects to represent a sound. For example, after students heard the teacher model a sound, the students then said the phoneme while simultaneously moving a marker representing the phoneme (Ball & Blachman, 1991). O'Connor et al. (1993) used a similar activity.

Oral production of individual sounds. Isolated individual sounds (phonemes) are orally produced by the teacher in a demonstration and by students in response and practice. For example, in Lie (1991) the first sound was taught by teacher modeling the isolation of the sound, students producing the sound, and teacher drawing attention to unique sound production features in the mouth (i.e., how the sound *feels* when you say it). See Table 1 for a summary of sound production and strategies for sound detection and manipulation (i.e., phonological awareness).

Explicit instruction. The following features common across the studies suggested an explicit instructional characteristic: (a) teacher modeling specific sounds, (b) student production of specific sound, and (c) direct teaching of phonological detection and manipulation. Direct teaching involved strategies (e.g., concrete representation) and scaffolding of difficult dimensions (i.e., providing graduated amounts of teacher, task, or materials assistance).

Letter-sound correspondence instruction. In a previous section, we discussed the utility of letter-sound correspondence instruction combined with phonological awareness to help students understand how sounds relate to written symbols in alphabet languages (see Area of Convergence # 4). Interventions that included letter-sound instruction with phonological instruction reported significant differences in reading and phonological awareness measures (Ball & Blachman, 1988; Byrne & Fielding-Barnsley, 1989; Cunningham, 1990; O'Connor et al., 1993).

Segmentation. Segmentation was the only phonological awareness dimension common to all studies; however, different sizes of phonological units

were segmented. For example, in one yearlong study (Lundberg et al., 1988), the segmentation task was scaffolded by beginning with larger and more natural phonological units (e.g., compound words and syllables) and ending with the smallest and most difficult unit (i.e., phoneme). Whereas instruction in segmentation was combined with other dimensions in six of the seven studies, segmentation was the single focus in Ball and Blachman's study (1991).

Dimensions of linguistic complexity. Common and consistent attention to the following linguistics dimensions has an explanatory function for consistent significant effects: (a) word length, (b) size of phonological unit, (c) relative difficulty of phoneme position in words, and (d) relative difficulty of phonological properties of words (all studies). (See Area of Convergence # 2 for an extended discussion of linguistic complexity and its importance to diverse learners.)

Our reasons for highlighting linguistic complexity are threefold. First, attention to linguistic complexity or difficulty is derived from theory that poor quality of perception and coding explain a large portion of differences in learning to read. Second, when instruction is scaffolded (e.g., gradational and intentional adjustment of task difficulty) by increasing the complexity of sound, the problematic aspect of reading (i.e., phonological features of language) is mediated. Thus, scaffolding linguistic complexity appears to meet specific needs of diverse learners. Last, significant effects of phonological awareness instruction on phonological development, reading, or spelling were found in all studies, implying that controlling linguistic complexity is helpful for all learners.

Word length was a function of size of phonological unit. When instruction focused on the phoneme size of phonological units, usually words were restricted to 1-3 phonemes. Requiring attention to 1-3 phonemes is obviously less complex than requiring attention to longer strings of phonemes, as in longer words. Our summary of size of phonological units indicates that nearly all studies utilized the phoneme

level and roughly 50% focused on the phoneme level and measured for effects on reading and spelling. Furthermore, onset-rime instruction usually focused on the initial phoneme (Byrne & Fielding-Barnsley, 1989; O'Connor et al., 1993). Comparisons of significant effects from instruction at the phoneme level, particularly when combined with instruction in letter-sound correspondences for each phoneme to non-significant effects for control groups, add support to the developmental literature, indicating that phonemic awareness does not develop naturally (Liberman & Shankweiler, 1985).

Relative difficulty of phoneme position in words was acknowledged in Ball and Blachman (1991), Byrne and Fielding-Barnsley (1989), Cunningham (1990), Lie (1991), Lundberg et al. (1988), and O'Connor et al. (1993). Initial position was taught first and significant attention to the phonological properties of words was an integral component of all interventions. For example, continuous sounds were introduced before stop sounds because stop sounds are more difficult to elongate and, therefore, more difficult to isolate for detection and manipulation. Specifically, Ball and Blachman (1991) indicated that stop sounds in initial position (e.g., tap) were introduced last because of articulatory distortion that occurs in segmenting. For example, /t/ becomes attached to the vowel /ta/ or to the /u/ sound because of the difficulty in only voicing the /t/. Similarly, Lie (1991) introduced consonant clusters toward the end of the intervention because consonant clusters are more difficult than continuants (e.g., /f/ in fish can become ffffish in contrast to /st/ in star which is impossible to elongate and difficult to isolate).

Independent Variables: Significant But Limited Evidence

The following independent variables effected significant improvement in a single study. Even though these variables resulted in significant effects, they require replication to obtain convergence:

1. A metacognitive component (i.e., direct teaching of application of phonological awareness skills in context of reading) was added to phonological awareness instruction (Cunningham, 1990).
2. Teaching phonemic detection as the phonemes appear in words (i.e., sequential instruction in phonemic awareness) was more effective than instruction in phoneme position (initial, medial, final). In addition, an articulation component (i.e., attention was drawn to sound production) was part of both types of instruction (Lie, 1991).
3. Two studies exclusively taught phonological awareness, or oral presentations only, without reference to letter-sound correspondences (Lie, 1991; Lundberg et al., 1988).
4. Two studies taught a broad array of phonological awareness skills (e.g., rhyme, detection, and segmenting) (Lundberg et al., 1988; O'Connor et al., 1993).
5. One study compared teaching a broad array of phonological awareness skills to segmenting and blending only and found comparable effects with both types of instruction (O'Connor et al., 1993).

Interaction of Instructional Variables and Learner Characteristics

The intervention studies in this review converged to provide strong support for phonological awareness instruction prior to reading instruction across abilities. In particular, two recommendations were made for the best time for teaching phonological awareness to specific ability groups:

1. Instruct in phonological awareness before formal reading instruction for children with disabilities or delays (O'Connor, 1993).
2. Begin phonological awareness instruction early in first grade or kindergarten for children with lower academic ability (Lie, 1993).

Thus, for diverse learners, strong effects across the studies underscored the critical nature of when diverse learners receive phonological awareness instruction. The effects add support to the third area of convergence, that phonological awareness has a causal relation to reading acquisition. Since phonological awareness has been established as one of the prerequisites for reading acquisition, the timing of phonological awareness instruction is obligatory, not optional.

Four studies provided three pieces of evidence relevant for diverse learners but without sufficient replication for convergence. First, Lie (1991) found that phonological awareness instruction improved the performance of diverse learners more than normally achieving students. In particular, in one study comparing effects by ability groups, effects were greater for diverse learners than for normal achievers; that is, diverse learners probably profited more from phonological awareness instruction (Lie, 1991).

Second, two studies comparing diverse learners and normally achieving students found that phonological instruction significantly facilitated reading acquisition for both diverse learners and normally achieving children (O'Connor et al., 1993; Vellutino & Scanlon, 1987). Third, a study with normal achievers indicated that a high degree of specificity may occur in initial learning. For example, /m/ may be detected in initial but not final positions (Byrne & Fielding-Barnsley, 1989), implying that if specificity occurs for normally achieving children it probably also applies to diverse learners. Last, positive effects for normally achieving students were found in all studies; phonological awareness instruction is efficient in that it is beneficial for all learners.

Summary

The presence of the following features in phonological awareness instruction appeared to produce the positive effects: (a) letter-sound correspondence, (b) instruction at the phoneme level of phonological units, (c) segmenting and

combination of segmenting with blending or detection, (d) attention to linguistic complexity, and (e) explicit instruction that includes oral production of isolated sounds. The importance and potential feasibility of phonological awareness instruction in authentic settings are suggested by two factors: (a) phonological awareness instruction made a significant difference across ability; therefore, it is efficient; and (b) difference was achieved in roughly 70% of the studies in an average of 15 minutes of instruction three times a week for nine weeks.

Linguistic complexity, the instructional variable that received greatest differentiation and, therefore, multiple dimensions of attention, supports our thesis logically, theoretically, and empirically: A large portion of reading disabilities can be explained by difficulties in phonological processing, specifically, phonological awareness. The finding that difficulty in perceiving and manipulating sounds of our language not only explains a large number of reading problems but can be taught, and taught across abilities at a young age, has powerful implications for the possibility of reducing reading failure. Controlling linguistic difficulty with instructional design principles of strategies, scaffolding, and integration of sound and graphic features of words contributed to positive effects across studies. The evidence from our review of primary and secondary sources provides clear and astonishingly convergent evidence that phonological awareness can be taught and that attention to instructional variables makes a significant difference on ease of reading and spelling acquisition for all learners.

Conclusion

Our discussion is summarized in four sections: (a) areas of convergence, (b) relation between phonological awareness and reading, (c) construct validity of phonological processing and awareness, and (d) instructional implications. In this summary, we draw attention to degree of convergence, issues, limitations of our review, and extension of our convergence from three articles representing current

research outside our review (Ackerman & Dykman, 1993; Felton, 1993; Torgesen, Wagner, & Rashotte, 1994).

Areas of Convergence

Our review of the research affirmed the importance of phonological awareness for reading acquisition. Results indicated that deficits in processing the sounds of language explain a significant proportion of beginning reading problems and correlated problems with older readers. The most encouraging lines of research suggested that the phonological awareness deficit is amenable to instruction, with particular attention to instructional variables that result in significant improvement. Moreover, the gains in phonological awareness directly affect ease of reading and spelling acquisition and achievement.

To summarize, five main areas of convergence establish the importance of the relation between phonological awareness and reading acquisition:

1. Phonological processing ability explains significant differences between good and poor readers.
2. Phonological awareness is a general ability with multiple dimensions.
3. Phonological awareness has a reciprocal relation to reading acquisition.
4. Phonological awareness is necessary but not sufficient for reading acquisition.
5. Phonological awareness is teachable and promoted by attention to instructional variables.

Relation Between Phonological Awareness and Reading

Of the 28 sources reviewed, roughly 50% were primary studies that found significant relations between phonological awareness and reading. Moreover, roughly 50% of those primary studies included students with identified reading disabilities. However, only 25% of those studies involving students with reading disabilities were intervention studies. None of the studies disagreed with the

hypothesis that phonological awareness plays a central role in the ease of reading acquisition. In considering the relation between phonological awareness and reading acquisition, we found strong support for the first area of convergence and emerging support for the third:

1. Phonological processing appears to explain the greatest amount of variance between good and poor readers. (Phonological awareness is a component of phonological processing).
3. Phonological awareness has a causal and a reciprocal relation to reading acquisition.

Issues surrounding the strength and direction of the relation between phonological awareness and reading are emerging, with support for relations in both directions: Phonological awareness facilitates reading and is facilitated by reading instruction.

Our review was representative of the general area of phonological awareness. Therefore, we were limited in depth of articles for any one aspect of phonological awareness. In addition, our purpose was instructional rather than etiological. For example, because of our focus, we did not examine explanations of reading disability outside of phonological processing in depth and our depth mirrored awareness rather than processing literature. However, we reacknowledge that phonological deficits do not appear to explain all reading disabilities, only a great proportion.

Construct Validity of Phonological Processing and Awareness

Throughout the review, we raised questions about the degree of support for the second area of convergence:

2. Phonological awareness is a general ability with multiple dimensions.

The issues parallel similar issues about the larger construct of phonological processing. The questions are construct validity questions. For example, we found the following two questions continue to be examined: (a) does rhyme belong to the

same construct as more difficult dimensions (e.g., segmentation); and (b) are segmentation and blending independent skills? However, we found consistent convergence about strength of relations among the dimensions. Therefore, we acknowledge that our use of "unitary construct" and "dimensions" may receive other interpretations.

The scope of our review did not provide an in-depth examination of any one dimension of phonological awareness. In addition, we draw attention to the need for future research with each dimension, relations among dimensions, and relations among dimensions and aspects of reading across age groups reiterated by several of the researchers. Recent research has begun to examine these very issues. Thus, phonological awareness and aspects of phonological processing are examined concurrently in more recent studies. In our discussion, we struggled to separate the examination of phonological awareness from phonological processing. The research trend implies the reason for our struggle: phonological processing and awareness are significantly interrelated and their interrelation is significantly related to reading (Ackerman & Dykman, 1993; Felton, 1993; Torgesen et al., 1994).

Instructional Implications

We found consistent support in a growing body of research for the fourth and fifth areas of convergence:

4. Phonological awareness is necessary but not sufficient for reading acquisition.
5. Phonological awareness is teachable and promoted by attention to instructional variables.

One important variable seemed to distinguish the studies in our review. Phonological awareness was taught. It was not left to develop in the absence of explicit instruction.

We also discussed the increased effects on subsequent reading achievement gained by combining phonological awareness instruction with instruction in letter-sound correspondences and explicit teaching. The simple lesson is that instruction that makes explicit the connections between letters and sounds and the segmental nature of language produces significant effects on subsequent reading and spelling achievement across reader ability and age. We note that our representative review was limited and did not include onset-rime research.

Even though recent research found phonological ability to be more closely related to general intelligence than found in earlier studies (Torgesen et al., 1994), it is appropriate to emphasize the consistency of improvement in reading and spelling acquisition across learners, particularly diverse learners. Similarly, even though the same research indicated that not all diverse learners achieve the significant gains reported for some groups (Torgesen et al., 1994), it is more appropriate to consider how design of instruction can be intensified for children who did not respond or benefit. We draw attention to synonymous use of *intense* and *explicit* by Torgesen et al. (1994) and the consistent recommendation for explicit instruction by the research reviewed.

Finally, we would like to emphasize that potential reading disability can be identified in young children and that diverse learners profit from phonological awareness instruction. In particular, researchers recommend that phonological awareness assessment be part of testing batteries for prereaders and that phonological awareness instruction be part of preschool and kindergarten curriculum. The available research produced emerging, yet inconclusive evidence of the optimal design of instruction across: (a) age and ability groups, (b) combinations of instructional variables, and (c) scope and sequence of instruction.

Phonological awareness research is characterized by diverse studies from various disciplines, with multiple perspectives, and by solid convergence. That is,

we know much about what causes a large proportion of reading disabilities, and we know how to identify students at-risk for, and those with reading disabilities. We are accumulating elements of instructional design that produce consistent and robust positive effects across ability. The result—we know much about how to prevent and ameliorate reading failure.

References

Adams, M. (1990). Beginning to read: Thinking and learning about print. Cambridge, MA: MIT Press.

Ball, E. W., & Blachman, B. A. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? Reading Research Quarterly, 24(1), 49-66.

Byrne, B., & Fielding-Barnsley, R. (1989). Phonemic awareness and letter knowledge in the child's acquisition of the alphabetic principle. Journal of Educational Psychology, 81, 313-321.

Cornwall, A. (1992). The relationship of phonological awareness, rapid naming and verbal memory to severe reading and spelling disability. Journal of Learning Disabilities, 25(8), 532-538.

Cunningham, A. (1990). Explicit vs. implicit instruction in phonemic awareness. Journal of Experimental Child Psychology, 50, 429-444.

Hurford, D. P., Darrow, L. J., Edwards, T. L., Howerton, C. J., Mote, C. R., Schauf, J. D., & Coffey, P. (1993). An examination of phonemic processing abilities in children during their first-grade year. Journal of Learning Disabilities, 26(3), 167-177.

Lenchner, O., Gerber, M. M., & Routh, D. K. (1990). Phonological awareness tasks as predictors of decoding ability: Beyond segmentation. Journal of Learning Disabilities, 23(4), 240-247.

Liberman, I. Y., & Shankweiler, D. (1985). Phonology and the problems of learning to read and write. Remedial and Special Education, 6(6), 8-17.

Lie, A. (1991). Effects of a training program for stimulating skills in word analysis in first-grade children. Reading Research Quarterly, 26(3), 234-250.

Lundberg, I., Frost, J., & Petersen, O.-P. (1988). Effects of an extensive program for stimulating phonological awareness in preschool children. Reading Research Quarterly, 23(3), 263-284.

Mann, V. (1993). Phoneme awareness and future reading ability. Journal of Learning Disabilities, 26(4), 259-269.

Mann, V. A., & Brady, S. (1988). Reading disability: The role of language deficiencies. Journal of Consulting and Clinical Psychology, 56(6), 811-816.

O'Connor, R. E., Jenkins, J. R., & Slocum, T. A. (1993). Unpacking phonological awareness: Two treatments for low-skilled kindergarten children. (Unpublished manuscript).

Rack, J. P., Snowling, M. J., & Olson, R. K. (1992). The nonword reading deficit in developmental dyslexia: A review. Reading Research Quarterly, 27(1), 29-52.

Snowling, M. J. (1991). Developmental reading disorders. Journal of Child Psychology and Psychiatry and Allied Disciplines, 32(1), 49-77.

Spector, J. (1995). Phonemic awareness training: Application of principles of direct instruction. Reading & Writing Quarterly, 11, 37-51.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. Reading Research Quarterly, 21, 360-407.

Stanovich, K. E. (1985). Explaining the variance in reading ability in terms of psychological processes: What have we learned? Annals of Dyslexia, 35, 67-96.

Stanovich, K. E. (1988). Explaining the differences between the dyslexic and the garden-variety poor reader: The phonological-core variable-difference model. Journal of Learning Disabilities, 21, 590-612.

Stanovich, K. E. (1988b). The right and wrong places to look for the cognitive locus of reading disability. Annals of Dyslexia, 38, 154-177.

Swanson, H. L., & Ramalgia, J. M. (1992). The relationship between phonological codes on memory and spelling tasks for students with and without learning disabilities. Journal of Learning Disabilities, 25(6), 396-407.

Torgesen, J. K. (1985). Memory processes in reading disabled children. Journal of Learning Disabilities. 350-357.

Torgesen, J. K., Wagner, R. K., Simmons, K., & Laughon, P. (1990). Identifying phonological coding problems in disabled readers: Naming, counting, or span measures? Learning Disability Quarterly, 13, 236-243.

Vellutino, F. R., & Scanlon, D. M. (1987). Phonological coding, phonological awareness and reading ability: Evidence from a longitudinal and experimental study. Merrill-Palmer Quarterly, 33(3), 321-363.

Vellutino, F. R., & Scanlon, D. M. (1987a). Linguistic coding and reading ability. In S. Rosenberg (Ed.), Advances in applied psycholinguistics (Vol. 2) (pp. 1-69). New York: Cambridge University Press.

Wagner, R. K. (1986). Phonological processing abilities and reading: Implications for disabled readers. Journal of Learning Disabilities, 19(10), 623-630.

Wagner, R. K. (1988). Causal relations between the development of phonological processing abilities and the acquisition of reading skills: A meta-analysis. Merrill-Palmer Quarterly, 34(3), 261-279.

Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. Psychological Bulletin, 101(2), 192-212.

Yopp, H. K. (1988). The validity and reliability of phonemic awareness tests. Reading Research Quarterly, 23(2), 159-177.

Separate References (not reviewed)

Ackerman, P. T., Dykman, R. A. (1993). Phonological processes, confrontational naming, and immediate memory in dyslexia. Journal of Learning Disabilities, 26(9), 597-609.

Felton, R. H. (1993). Effects of instruction on the decoding skills of children with phonological-processing problems. Journal of Learning Disabilities, 26(9), 583-589.

Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1994). Longitudinal studies of phonological processing and reading. Journal of Learning Disabilities, 27(5), 276-286.

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Figure Captions

Figure 1. Secondary and primary sources for the synthesis of the research on phonological awareness and its relation to reading acquisition.

Note: PA refers to phonological awareness.

Figure 2. Overview of chapter on phonological awareness.

Figure 3. Components of phonological processing and dimensions of phonological awareness.

Figure 4. Range of difficulty for phonological awareness dimensions (Yopp, 1988).

Table 1
Presentation Features: Isolated sound modeling, Student sound production, Strategies

STUDY	Ball & Blachman (1991)	Bryne & Fielding-Barnsley (1989)	Cunningham (1990)	Lie (1991)	Lundberg et al. (1988)	O'Connor et al. (1993)	Vellutino & Scanlon (1987)
Teacher model isolated sound	Yes	yes	yes	yes	yes	yes	---
Student produce isolated sound	yes	yes	yes	yes	-----	yes	yes
Concrete representation	yes	yes	yes	no	yes	yes	yes
Strategy or Activity	say it & move it	----	think-aloud strategy	feel the articulation & listen. segmentation strategy	clap, dance, march, move markers	touch and say	decoding, segmentation

Note: ___ indicates absence of information.
Concrete representation is also indicated as an activity or strategyy

Secondary Sources

Author(s)	PA dimension	Participants	Purpose
Adams (1990)	all dimensions	preschoolers-adults all levels of ability	Synthesis of reading research, acquisition and disabilities
Liberman & Shankweiler (1985)	rhyme, segmentation, all dimensions	children-adults normal development reading disability	Descriptive narrative. Phonological development and ability differences related to reading acquisition
Mann & Brady (1988)	phoneme level, rhyme, phonemic manipulation	children-adults reading disability	Descriptive narrative. Summarize role of language deficiencies in reading disability
Rack et al. (1992)	general PA & segmentation	reading disabled, dyslexics, normally achieving 7-14 years old	Review. What aspects of word recognition are problematic for readers with dyslexia?
Snowling (1991)	rhyme, segmentation, onset-rime & phonemes	normally achieving, low performing, reading disabled, language delayed, illiterate adults, families	Descriptive narrative. Discover cause of reading disability. Develop instructional implications
Spector (1995)	all dimensions	Preschool-beginning readers	Descriptive narrative. PA interventions and recommendations
Stanovich (1985)	general	Learning disabled, remedial reader, normally achieving children-adults	Descriptive narrative. Summarize research convergence on causes of reading failure.
Stanovich (1986)	general, phoneme level	reading disabled and poor readers	Descriptive narrative. Relation between reading & cognitive processes. What individual differences contribute to cascading reading problems?
Stanovich (1988)	rhyme, oddity	beginning readers-7th grade skilled, reading disabled, low performers	Deficit model. Development of phonological core deficit model for reading disabilities
Torgesen (1985)	-----	reading disabled	Descriptive narrative. Causal relation between memory processes & specific reading disability

Secondary Sources Continued

Torgesen et al. (1990)	phonological processing	reading disabled, young children	Descriptive narrative. Assessment & diagnosis of phonological coding problems
Vellutino (1991)	general	-----	Descriptive analysis. Convergent findings of code- vs meaning-based beginning reading instruction
Vellutino & Scanlon (1987a)	general, segmentation	normally achieving reading disabled linguistically diverse grades 2 & 6	Descriptive analysis. Examine evidence for linguistic coding basis to reading disabilities
Wagner (1986)	general, segmenting & blending, phonological processing	reading disabled	Review. Causal relation between phonological processing and reading Can phonological processing be trained? What is phonological processing?
Wagner (1988)	blending & segmenting	beginning readers	Meta-analysis. Causal relations between phonological processing & reading acquisition
Wagner & Torgesen (1987)	phonological processing & awareness	Young children	Descriptive analysis. Nature of phonological processing & causal role in reading acquisition

Primary Sources

Author(s)	Dimension of PA	Participants	Purpose
Ball & Blachman (1991)	phonemic segmentation	Normally achieving kindergarten children, N=151	Intervention. Explore if segmentation can be taught. Explore effect on reading & spelling. Explore effect of segmentation + letter-sound instruction on reading & spelling
Byrne & Fielding-Barnsley (1989)	detection of initial phoneme segmentation	Preliterate children ages 3-5 5 experiments w/ N=11-30	Intervention. Explore what conditions lead to alphabetic principle
Cornwall (1992)	phonemic deletion & blending	Learning disabled/severe reading disabilities, ages 7-5 to 12-3 years, N=54	Correlational. Explore relation of PA, naming speed, & verbal memory on word attack & identification, comprehension, & spelling to find predictors of achievement
Cunningham (1990)	phonemic segmentation & blending	Normally achieving kindergarten N=48	Intervention. Does PA instruction affect K and 1st-grade reading? Does meta-level instruction along with PA affect reading?
Hurford et al. (1993)	phonemic discrimination & segmentation	Normally achieving, N=187 Low performers, N=10 Learning disabled, N=12 1st graders	Correlational. Examine PA development by group ability. Examine predictability of ability group membership by reading, IQ, and PA
Lenchner et al. (1990)	phonemic segmentation, blending, & manipulation	Normally achieving male, N=19 Reading disabled male, N=19 4th grade	Correlational. What is relation among measures of PA and phonetic decoding with older students?

Primary Sources Continued

Lie (1990)	segmentation	Total 1st graders, N=208 Subgroups High intelligence, N=18 Normal ", N=18 Low ", N=18 Norwegian	Intervention. Will PA instruction affect 1st-grade reading & spelling, 2nd-grade reading & spelling? Compare positional v. sequential segmentation instruction. Will low students benefit more?
Lundberg et al. (1988)	rhyme, segmentation of all phonological units, initial phoneme identification	Normally achieving, N=390 Kindergarten, Danish children	Intervention. Can PA be taught before reading instruction? What is learned during PA instruction? Does training last, affect reading & spelling? How specific are effects--effects on general language development?
Mann (1993)	phonemic segmentation	Normally achieving, N=52male, 48 female Kindergarten	Correlational. Relation between PA and future reading ability
O'Connor et al. (1993)	onset-rime segmentation & blending, broad array of PA skills	Low performers, N=88 High skilled, N=25	Intervention. Unpack PA. Examine intervention benefits for low-skilled. Trace PA development under instruction. Transfer test of reading & spelling
Swanson & Ramalgia (1992)	phoneme matching, rhyme	Normally achieving, N=32 Reading disabled, N=27 Ages 8.83-13.75	Correlational. Compare normal & diverse reliance on phonological info in memory & spelling. Relation between phonological info & spelling

Primary Sources Continued

Vellutino & Scanlon (1987)	phonemic segmentation	Total N=300; 2nd & 6th graders Subgroup High-skilled, N=75 Low-skilled, N=75	Intervention. Look for evidence to support causal relation between phonological deficit and reading disabilities
Yopp (1988)	all dimensions	Normally achieving, N=96 Kindergarten	Correlational. Determine reliability, validity, & relative difficulty of PA tests

Figure 1. Secondary and primary sources for the synthesis of the research on phonological awareness and its relation to reading acquisition.
Note: PA represents phonological awareness.

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Figure 4. Range of difficulty for phonological awareness dimensions (Yopp, 1988).

Phonological Awareness Chapter

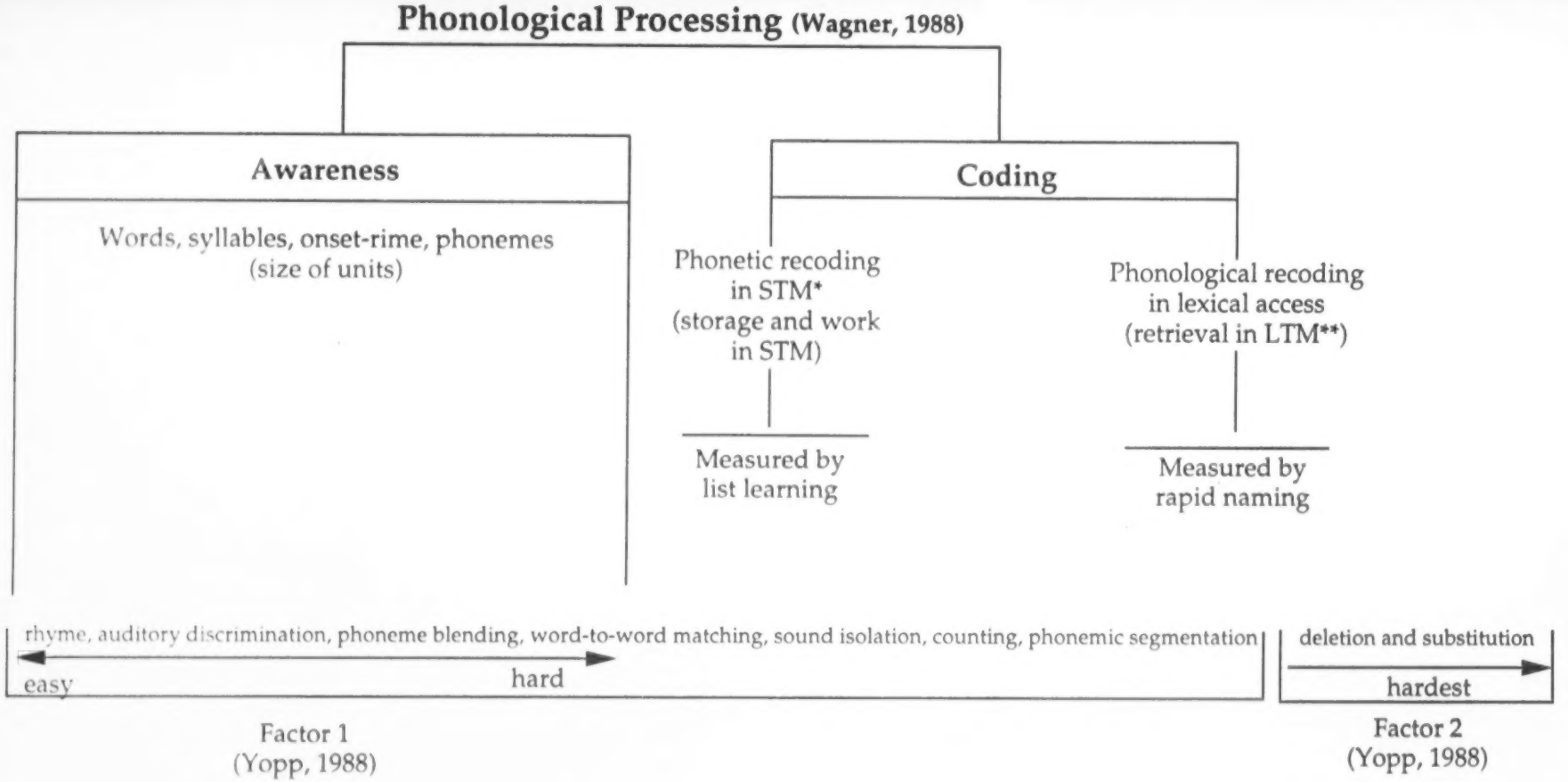
Introduction

Methodology

Areas of Converging Evidence

- Phonological Processing Abilities Explain Significant Differences Between Good and Poor Readers
  - Components of Phonological Processing
  - Relations Between Phonological Processing and Learner Characteristics
  - Summary
- Phonological Awareness Is a General Ability with Multiple Dimensions
  - Dimensions
  - Range of Difficulty
  - Factors that Affect Difficulty
  - Important Features of Assessment
  - Factor that Affects Performance
  - Summary
- Phonological Awareness Has a Reciprocal Relation to Reading Acquisition
  - Hypothesized Relations
  - Causal Relation
  - Product of Reading Instruction and Practice Relations
  - Reciprocal Relation
  - Limited Importance of Relation
  - Summary
- Phonological Awareness Is Necessary but not Sufficient for Reading Acquisition
  - Phonological Awareness and Alphabetic Understanding
  - Instruction in Phonological Awareness and Letter-sound Correspondences
  - Coding and Automaticity
  - Summary
- Phonological Awareness is Teachable and Promoted by Attention to Instructional Variables
  - Overview of Studies
  - Effects of Phonological Awareness Instruction
  - Independent Variables: Explanations for Positive Effects
  - Independent Variables: Significant but Limited Evidence
  - Interaction of Instructional Variables and Learner Characteristics
  - Summary
- Conclusion
  - Areas of Convergence
  - Relation Between Phonological Awareness and Reading
  - Construct Validity of Phonological Processing and Awareness
  - Instructional Implications

Figure 5.



*Short Term Memory
**Long Term Memory

Figure 3. Components of phonological processing and dimensions of phonological awareness.

Range of Difficulty for Phonological Awareness Dimensions (Yopp, 1988)

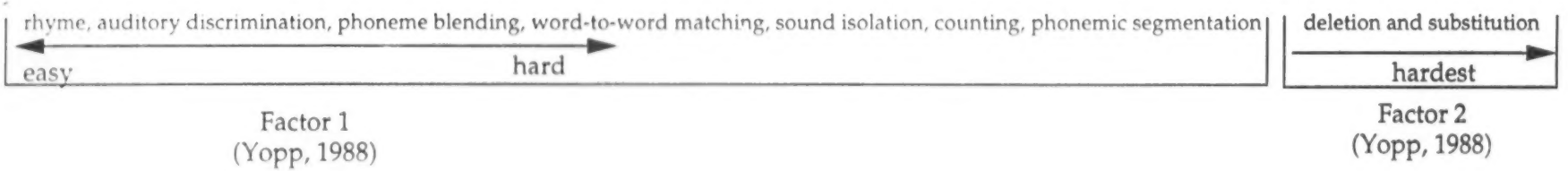


Figure 4. Range of difficulty for phonological awareness dimensions (Yopp, 1988).